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5. Living in the Aftermath of Chernobyl—Lessons from the Recovery

The accident at Chernobyl resulted in unprecedented radiological contamination of a densely inhabited area. Local and national authorities were not prepared for an incident of such size and severity. How did people in the region react and what measures did they take to cope after the accident? How did the cleanup of the area proceed and what was life like in the affected areas?

The reports of two women with first-hand, personal experiences living in the aftermath of Chernobyl help to answer these questions. The first is Larisa Leonova, a chemist with the U.S. Environmental Protection Agency who was one of the early responders to the Chernobyl event. At the time of the accident, she was managing a laboratory in Moscow on a part-time basis while earning her PhD in chemistry. Larissa volunteered to help with the response and traveled to Kiev several weeks after the incident. She worked in the area around Pripyat, trying to convince local residents to leave the area.

> *[Image – LL8 3:51:54 – 3:52:21 "My Name is Larisa Leanova and I live in United States oh, it's my twentieth years. And um, back when Chernobyl happened I was ah, twenty-eight years old and four years is graduated from ah, university. And I was working as a chemist, basically part time a lab manager and part time doing my PhD research work. Back when the Chernobyl happened I was in Moscow, I always lived in Moscow."]*
>
> *[Image—LL8 4:00.44--?? "So, I basically ah, set up the vacation time and I called to my uncle in the Kiev and I said like you know me and another group of ah, chemists we are ready to provide whatever the type of the help we can."]*

Vira Yakusha is a computer scientist with a consulting firm in Washington DC. At the time of the accident, Vira was a resident of Kiev and a recent graduate of Kiev University. Vira was pregnant with her first child, and she brings the perspective of an expectant mother and member of the general public reacting to the events occurring around her.

> *[Image – VY4 2:33:03 – 2:34:00 "My name is Vira Yakusha and ah, I was born in Kiev. And ah, I lived there for my entire life. And I loved the city a lot. And ah, I was there as a just a member of general population when Chernobyl tragedy struck. And so my perspective is a perspective of a lay person who is not professionally involved in the nuclear, in the nuclear industry, but who was, whose life was directly affected by what happened. And ah, my story is a story of person who is trying to comprehend what's going on and trying to do the best, what is best for my family, for health of my family and ah, trying to live my life as ah, as simple as possible if it's possible in the difficult circumstance."]*

Using the first-hand accounts of Larissa and Vira, we will look at several key aspects of the recovery from a radiological event: countermeasures to reduce exposure to the radiation released during the incident, coping with contamination of the food supply, and the special health concerns for pregnant women and their children associated with the accident.

5.1 Limiting Exposure and Cleaning Up

Once the pressing issues of putting out the fires, evacuating the immediate area, removing debris and isolating the reactor were taken care of, attention turned to the impact of the accident on the broader area. Radioactive dust and dirt were a major source of contamination in both agricultural and urban areas.

Because of the magnitude of the accident, local and national authorities were initially uncertain how to proceed. Larissa Leonova, a chemist who now works for the U.S. EPA, volunteered to travel to Kiev in the first weeks after the accident to lend a hand.

> *[LL4:01:56- 4:02:35 "our group of volunteers were basically invited by um, some sort of the organization which were created back there and basically consist um, of very strange group of people who -- represented by Army and by some ah, local officials which were not scientists. They were just the politicians and they were trying, trying to create some sort of the response. And um, again you know first couple of weeks it was basically you know not enough data or no information about plume or no information which territory it's more affected."]*

> *[LL4:03:03 – 4:03:14 "we were among of the first, to my knowledge, volunteer group who went there and who got um, ah, who were involved in ah, um, some sort of the response."]*

One of the first assignments of the group of volunteers was to provide the local populace with some basic guidance about how to limit their exposure to the radioisotopes released by the plant.

> *[LL4:05:05 – 4:05:25 "that's the season when everybody in the Ukraine um, pick up the strawberries. And Ukraine, it's very high in the strawberries and actually you know like um, everybody over there -- middle of the May and June the strawberries is the best place -- taste unbelievably good and everybody has a strawberry growing in their backyards and garden."]*

> *[LY4:05:40 – 4:05:51 "So, the first advice which we wrote was very silly, we're saying like do not eat the strawberries if they are you know like right besides the dripping line um, from your roof."]*

> *[LL4:06:00 –4:06:15 "The other thing was we were basically advising that ah, try to have at least a bucket of water near the entrance of your door and before -- after you coming from the street to your house, wash you um, shoes and remove your shoes, try to not bring the additional dust."]*

Once the authorities began to realize the significance of the accident, they began to issue further guidance on ways to reduce exposure to contaminated dust:

> *[VY1 01:34:00 - 01:34:30 "First Monday after, uh, after Easter so it was May -- May 5th, and the May 5th was the first day when, uh, when authorities, uh, Soviet authorities*

officially on the radio started to say well, things are, um, under control, but, um, for, just for personal precautions please shower regularly, try to keep dust out of the rooms, and, uh, keep your clothes laundered often, and cover the food and bread if you buy something so, uh, it's, uh, to prevent dust from, uh, coming on the food. Uh, so there were first official guidelines for general population to minimize, uh, the exposure."

VY3 02:25:56 - 02:26:32 "After that first announcement, ah, they say that you should wash ah, take shower often, wash your ah, clothing often. Ah, try to prevent dust from setting on your household items. Ah, there was more information. And ah, it will become more and more detailed and instructions more elaborate this time. Then they were not that afraid to accept or admit that something wrong is going on. And, ah, we were doing this religiously. Our family. We were trying to follow everything and some more."

VY3 02:14:21- 02:14:18"my family just tried to keep everything as clean as possible. Free from dust, from dirt. But ah, the thing is that you cannot be 100% sure, of course. And later on, of course, it was not about the surfaces, of your living space, but more about the food that you are getting and ah, and ah, probably some accidental contamination that, for example, like there, rooftops for um, perceived to be very dirty. And they were in fact. So we were told or people were telling the children were told to avoid the downpours from the, from the roof, for example. If ah, water is pouring from the roof, it' probably, if it goes and fills in your overcoat, you don't want to have your overcoat to get dirty and to get rid of it later on."]

As we can see from these examples, one of the primary ways people are exposed to radioactivity after a radiological event is through contaminated dust and soil that adheres to hair, skin, clothing, and shoes. One effective way to reduce this exposure is to shower frequently, launder clothing frequently, remove shoes and outer clothing before entering living areas, and practice general good housekeeping to reduce dust and dirt indoors. These hygiene precautions were successful in areas like Kiev after the Chernobyl accident, and they are also recommended by Centers for Disease Control and others.

The decontamination activities performed after Chernobyl gives us an idea of what techniques are most effective to reduce the dose received from exposures to radiation. In the days following the accident, the area around the Chernobyl plant and the most contaminated areas in the exclusion zone were sprayed with organic solutions to create a thin film that would immobilize dust. Buildings, vehicles, and city streets were washed frequently and sprayed with water to suppress dust. *[Image: workers spraying water on trucks, buildings, and streets.]*

Much of the radioactivity from the accident was concentrated in surface soil, plants, on asphalt and concrete, and to a lesser extent on roofs and walls. Streets in Kiev were washed daily in the weeks following the accident. In surrounding areas, roads and buildings were washed, residential areas were cleaned, contaminated soils were removed--especially along drip lines next to buildings--and sediments were removed from the bottom of reservoirs. *[Image: men peeling back sod (42-15785116).]* Decontamination activities concentrated on schools, hospitals and other high-use buildings. Overall, tens of thousands of public buildings and residences were treated in about 1000 cities and towns.

According to the International Atomic Energy Agency (*IAEA Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience)*, street cleaning, removing trees and shrubs, and plowing soils in yards to bury the surface soils were efficient and inexpensive means of achieving significant reductions of dose. Roofs and walls also contribute to dose, but they are costly and difficult to clean and thus present a more difficult issue in the event of a radiological emergency in an urban setting. [*Images for this section could be a montage of people scrubbing, plowing, and spraying the streets, buildings, and yards.]*

> *VY4 02:45:17 – 2:45-31 "I've heard from people who stayed there that um, street washing was much more frequent during that memorable summer that there is. When much more often than usual and they were doing a good job of keeping the city clean after all."*

> *VY4 2:58:48 – 2:59:05 "In my understanding and my feeling that ah, in the long term during that summer, during consequent months, government did a lot. I mean what they could at this given time. Given level of technology. To clean up what they could."*

> *VY4 02:57:04 – 2:57:12 "Not really humanly possible ah, to get things 100% clean as they were before. Ah, you had to really invent a time machine for that."*

> *VY4 2:57:19 – ? "For example contaminated soil could be put out of agricultural use. Some things could be thrown away but you cannot make clean everything. You just, it's impossible. Period. And this what ah, was um, a perception that government did what they could do."*

The following websites provide good information on actions that can be taken to limit exposure after a radiological incident. [*Images: CDC rad website and address www.bt.cdc.gov/radiation, image of DHS Ready.gov rad website and address http://www.ready.gov/america/beinformed/radiation.html.*

There's also a not-so-great quality but understandable image of a silhouette guy showering off yellow dots at http://www.remm.nlm.gov/deconimage.htm]

5.2 Managing the Food Supply

The massive amount of radioactive fallout from Chernobyl also had far-reaching consequences for the food supply in the contaminated area. Internal exposure to radiological contaminants through consumption of contaminated food and water is a very significant exposure concern. Early responders were advised not to eat locally grown food, and surprisingly, to drink red wine instead of water:

> *[LL8: 4:20:00 – 4:20:06 "We were ordered -- we were basically -- that was our order to drink red wine, not drink water. So, that was our liquid consumption. "and LY8 04:27:54 – 4:28:08 "We were not given anything besides red wine. We were strictly advised not drink water or milk. And we were advised do not eat any um, grown -- locally grown product -- produce, nothing, no vegetables, no fruit, nothing."]*

Many locals used common sense and avoided eating locally grown foods that were probably contaminated:

> *[LY8 4:14:29 - 4:14:45 "We found the people who were very educated and um, they were not eating any fresh food since the accident, since the first they heard about the accident. They were trying to eat canned food only."*

Local authorities prohibited animal feeding with pasture grasses in the affected areas and rejected milk based on radiological monitoring. Many thousands of agricultural and domestic animals were slaughtered immediately, and the remainder evacuated. *[Images – pigs and cows being screened with radioactivity meters by a worker in a moon suit (ex: 42-15882699 and* 0000316032-056*), images of dead fish on the shore near the reactor]*

People living in the area tried to obtain imported food as much as possible, but this was often difficult. Vira Yakusha explains her dietary habits when she returned to Kiev with a young baby in the months following the accident:

> *[VY3 02:27:15 – 2:27:43 Well first concern ah, at that point was the food. And ah, food and again official line was that all food is carefully screened. Sources of food that contaminated milk or other ah, ah, necessities are discarded and thrown away and so you don't have worry about that. But of course we did worry. And of course we, we will try to buy imported food. As much as it was possible. But it was not that readily available.*
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> *VY3 2:22:18 – 2:24:00 "…if there is a cereal made in Hungary, probably there is less ah, a less chance that it's radiologically contaminated than the sour cream made on the local factory. Because God knows where this local factory gets their milk from. And in the first couple of weeks we were so ardent about it that I even didn't eat any bread because bread was definitely make over, made of local grains. And again, local grains could be contaminated. But after a couple of weeks without bread, I said you know what? I'm going to eat bread. Because I cannot. I need to eat something, right?"*
>
> *[VY3 02:28:35 – 2:28:51 "So there are very, there are always efforts. There are always efforts to make sure your food sources are clear. But it is almost impossible. So you have to accept at some point that you have to, continue with your life or otherwise you will just go mad."*
>
> *VY3 2:27:43– 2:28:12 "And of course, ah, ah, we will try to buy imported food. As, as much as it was possible. But it was not that readily available. And again, there were um, ah, some things that you cannot buy imported. For example, like your greens, your apples. And ah, sometimes you will come across imported apples with big luck. I remember my husband bought five kilos of ah, ah, a golden ah, golden delicious which is a common brand in America and they were ah, grown somewhere ah, from north of imported apples. And we were very happy. We were feeding our baby these apples for quite a long time while they lasted."*

As time went on and the threats posed by contaminated farmland became better understood, the local authorities undertook more sophisticated measures to manage agricultural production from contaminated farmland. According to the International Atomic Energy Agency, some of the most effective countermeasures were treating the soil; removing some areas from agricultural production altogether based on radiological screening; switching animals to clean fodder from uncontaminated areas; and feeding animals dietary supplements such as cesium binders to help the radio nuclides pass through the animals without being incorporated in food products. *[Images: workers in suits walking through a field (42-15800571), a man with a rotor tiller (*42-15784775*), peasant gardeners (DWF15-682237), and a fallow field with a rad sign in front of it (42-15784775)]*.

The countermeasures described above went a long way to reducing the radiological contamination of foods from the affected areas. However, the long half life of some of the contaminants, particularly Cesium-137, as well as economic hardships following the fall of the Soviet Union resulted in continued barriers to agricultural restoration in the area.

ARE THERE ANY GOOD WEB SITE CITATIONS HERE RE: FOOD? WASN'T ABLE TO FIND MUCH

5.3 Coping with Special Health Concerns

For the people affected by Chernobyl, radiation exposure of unborn babies was a major concern. Vira Yakusha was living in Kiev and pregnant with her first child at the time of the accident. Upon learning of the disaster, she tried to leave Kiev as soon as she was able, to try to put as much distance between her baby and the radiation emergency as she could. Unfortunately, many people were trying to do the same, and Vira was unable to buy a train or plane ticket *[image –we could show a few generic Russian-looking group queued up at a ticket booth, as Vira spoke about the crush of people waiting to purchase airline or train tickets.]* Vira discussed this situation urgently with her husband and her family:

> *VY1 1:29:20 - 01:29:27 "I was really determined, uh, to keep my baby healthy and, uh, as far as harm's way was possible."*
>
> *VY1 1:50:49 "I don't know what to do, it's impossible to buy tickets for -- for a plane, it's impossible to buy tickets for a train, but we need to get you out. And we were sitting in the kitchen and trying to figure out what kind of plan that could work"*
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> *VY2 01:51:36 – 1:51:41 "And so we were thinking about this and that, and there is suddenly, um, uh, a buzz on the door …"*
>
> *VY2 1:51:54 – 1:52:44 "I opened the door and this is, uh, again my friend, uh, Yenna, who, uh, head of the family who were taking me to Karnyov, and he sort of looks grim, and he said you know what, I made a decision, uh, I take my, uh, girls away to Mosc -- I'm taking my girls away to Moscow because I want to get my kids out of here as soon as possible. And his, his thinking was pretty much the same that if the government admits so much that, uh, it's dangerous, then it's really, really dangerous. Yeah, and he said, um,*

okay, so my car is downstairs, uh, waiting for you, um, my wife and my kids are in the car, and we have still one place left in this car, this is for Vira. If you want to go with us you have 40 minutes to pack yourself."

[Images – Possibly a man standing next to an old, Soviet-style car? A family around a table talking about something obviously upsetting or pressing.]

Vira left Kiev that night, and four months later in Moscow she gave birth to Doreena, a healthy baby girl. We can't say whether getting out of Kiev, about 70 miles from the disaster, in the weeks after the accident helped her give birth to a healthy child. Her child may very well have been fine had she continued to live in Kiev.

VY1 01:32:46 – 1:33:18 "Doreena, and she is, uh, 21 years old right now, and, uh, I never had any, uh, uh, health problems with her that I should, could attribute to potential exposure. But unfortunately, uh, my understanding of the nature of the whole thing is that you never can, if you have some sort of health problem you can never be 100 percent sure if it was the result of, uh, your exposure to the radioactivity at some point or it's just your particular body type or, uh, other factors that were contributing."

Reflecting on her actions many years later, Vira feels that she made the right choice given the information that she had:

VY4 02:42:38 – 2:43:38 "My personal feeling is the health of your children or your child is the first priority, because this is something that you are ulta, ultimately responsible for. So I would say what I said to myself. Put as many miles as you can between the source of radiation and yourself and your baby and try to get as much information as much reliable information as you can. And try to… I mean panic is never a good helper or a good advisor. So probably understanding is our best weapon and to know how things work and what is real danger and what is imagined danger. It is a real important difference. And the more you understand, the better your choices are, the better your behavior is. At least you're choosing between least, least possible evils. And ah, it's impossible to be in a perfect world. But in our imperfect world, you have to make your own choices. And it's better to be based on the, on the ways of reason."

[Note – one danger of this section is that it gives some cause for panic – I feel that the 'woman in the street' perspective is valuable, but the message is clearly to flee the area, and it appears that Vira's actions may have saved the day. If I was a pregnant woman watching this, I'd think – get away first and ask questions later. Just want to be sure we're OK with that message.]

Exposure to radiation can cause health problems depending on the type of radiation, the exposure, and the individual's general health and susceptibility to illness. Some populations are particularly susceptible to the effects of radiation, and these include pregnant women and especially unborn babies. The Centers for Disease Control say that unborn babies are particularly sensitive to radiation during their early development, between weeks 2 and 15 of

pregnancy, and can experience severe health effects such as birth defects, stunted growth, and brain damage. From 16- to 25-weeks, unborn babies may experience health consequences, but only if the doses radiation are very large, such as those large enough to cause radiation sickness in the mother. After the 26th week of pregnancy, the radiation sensitivity of an unborn baby is similar to that of a newborn. More information about the special health concerns associated with exposure to radiation during pregnancy can be found on the Centers for Disease Control Web site. *[Image – CDC web site and fact sheet at http://www.bt.cdc.gov/radiation/prenatal.asp]*